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Hinge Craniotomy for Traumatic Brain Injury: Surgical Technique

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Abstract

Hinge craniotomy has been described as an alternative to decompressive craniectomy for the control of intracranial pressure in traumatic brain injury and stroke. In this study, the authors highlight critical steps in performing a hinge craniotomy and present a clinical case of a patient with traumatic brain injury.

Keywords

- hinge craniotomy
- traumatic brain injury
- intracranial hypertension

Traumatic brain injury (TBI) and stroke are public health concerns worldwide. It is estimated that 69 million individuals worldwide suffer a traumatic brain injury each year.[1] There are approximately 13 million new incident strokes globally each year.[2] Intracranial hypertension significantly contributes to morbidity and mortality in both TBI and stroke. Raised intracranial pressure (ICP) compromises cerebral blood flow and is the primary cause of secondary brain injury. The current protocols and guidelines in TBI and stroke include recommendations for controlling intracranial hypertension.

Intracranial hypertension is managed through a tiered approach. The multiple tiers include general measures such as elevation of the head end, medical measures such as osmotic therapy, and surgical measures. The main surgical procedure to control ICP has been a decompressive craniectomy (DC). DC is a surgery that involves partial skull removal and dural opening, allowing additional space for brain expansion and leading to reduced ICP and subsequent improvement in cerebral perfusion.

Although a commonly used procedure, DC is not a perfect solution to the problem of intracranial hypertension. Randomized controlled trials of DC in TBI—Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension (DECRA) and Randomized Evaluation of Surgery with Craniectomy for Uncontrollable Elevation of Intracranial pressure (RESCUEicp)—have shown improvement in mortality following DC but poor functional outcomes.[3,4] Similarly, the Hemicraniectomy after middle cerebral artery infarction with life-threatening edema trial (HAMLET), Decompressive Surgery for the Treatment of Malignant Infarction of the Middle Cerebral Artery (DESTINY), and Decompressive Craniectomy in Malignant MCA infarction (DECIMAL) trials of DC in stroke have not demonstrated a significant benefit5.[5] Current TBI and stroke guidelines suggest using DC for refractory intracranial hypertension.

The procedure is associated with many complications—some of which are unique to DC. Common complications associated with the procedure include new hematomas, progression of contusions, superficial and deep wound infections, meningitis, hydrocephalus, subdural hygromas, and cerebrospinal fluid (CSF) leaks. Patients may also suffer from "syndrome of the trephined"—a rare and unique complication from a sinking skin flap. The complications of the procedure are not limited to the primary surgery itself. Following DC, patients must undergo cranioplasty for replacement of the bone flap. The need for a second surgery and complications associated with cranioplasty can make the procedure of DC quite morbid.

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Three independent investigators suggested an alternative to DC in 2007: hinge craniotomy (HC).[6–8] They described the technique of resecuring the bone flap in a noncircumferential pattern to the skull, allowing it to hinge at one point. This provides space for the brain to expand through the defect, raising the bone flap. By enabling the bone flap to remain in situ, there would be minimal cosmetic defect. Once cerebral edema resolves, the bone flap would fall back into place, limiting the need for a subsequent cranioplasty.

HC has multiple advantages—maintained cerebral protection, avoidance of second surgery, and avoidance of unique DC-related complications. Numerous studies have demonstrated adequate control of ICP and comparable outcomes with HC in both TBI and stroke. A study conducted by Mishra et al[9] in our institute demonstrated no significant differences in outcomes at the end of 1 year following either HC or DC for TBI and stroke. They also noted a lower rate of complications with HC compared with DC.

The aim of this video (►**Video 1**) is to demonstrate the surgical technique of HC and highlight the nuances in performing the technique appropriately to ensure adequate decompression.

Video 1 Video describing the steps of performing a hinge craniotomy in a patient with traumatic acute subdural hematoma.

Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0044-1782690.

Conflict of Interest
None declared.

References

1 Hutchinson PJ, Kolias AG, Tajsic T, et al. Consensus statement from the International Consensus Meeting on the Role of Decompressive Craniectomy in the Management of Traumatic Brain Injury: consensus statement. Acta Neurochir (Wien) 2019;161(07): 1261–1274
2 Saini V, Guada L, Yavagal DR. Global epidemiology of stroke and access to acute ischemic stroke interventions. Neurology 2021;97 (20, Suppl 2):S6–S16
3 Cooper DJ, Rosenfeld JV, Murray L, et al; DECRA Trial Investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group. Patient outcomes at twelve months after early decompressive craniectomy for diffuse traumatic brain injury in the randomized DECRA clinical trial. J Neurotrauma 2020;37(05):810–816
4 Hutchinson PJ, Kolias AG, Timofeev IS, et al; RESCUEicp Trial Collaborators. Trial of decompressive craniectomy for traumatic intracranial hypertension. N Engl J Med 2016;375(12): 1119–1130
5 Cruz-Flores S, Berge E, Whittle IR. Surgical decompression for cerebral oedema in acute ischaemic stroke. Cochrane Database Syst Rev 2012;1(01):CD003435
6 Schmidt JH III, Reyes BJ, Fischer R, Flaherty SKJH SUse of hinge craniotomy for cerebral decompression. Technical note. J Neurosurg 2007;107(03):678–682
7 Goettler CE, Tucci KA. Decreasing the morbidity of decompressive craniectomy: the Tucci flap. J Trauma 2007;62(03):777–778
8 Ko K, Segan S. In situ hinge craniectomy. Neurosurgery 2007;60(4, Suppl 2):255–258, discussion 258–259
9 Mishra T, Kishore K, Jayan M, et al. When the bone flap expands like bellows of accordion: feasibility study using novel technique of expansile (hinge) craniotomy for severe traumatic brain injury. Neurol India 2021;69(04):973–978

